REVIEW OF THE HAWAIIAN DROSOPHILA (ANTOPOCERUS) HARDY[1]

D. Elmo Hardy
Department of Entomology, University of Hawaii, Honolulu, Hawaii 96822

ABSTRACT—The following new species of *Drosophila* (*Antopocerus*) are described from Hawaii: **kaneshiroi**, **yooni**, **curvata**, **nigricolor**, **apicalis**, and **stigma**. A key to species of *Drosophila* (*Antopocerus*), based on males, is included.

The *Antopocerus* taxon was first set up as a new genus endemic to the Hawaiian Islands. It is differentiated from other Drosophilinae by the unusual secondary sexual characters peculiar to the males: By having the first antennal segment comparatively large, porrect, extending well beyond margin of front and the arista with numerous, closely placed hairs along the dorsal margin and the ventral margin devoid of setae (fig. 1). Also the ornamentation and development of the front tibia and tarsus of the males is distinctive from other *Drosophila* (fig. 6–19); the anterior surface of the front tibia is flattened and bare of setae, this character seems to be unique to *Antopocerus*. Somewhat similar types of leg ornamentation are present in some other Hawaiian *Drosophila*, but not in the same combination of characters.

The illustrations were made by John W. Grubb, University of Hawaii. Dr. K. Y. Kaneshiro, University of Hawaii, had considerable input into this study and I greatly appreciate his valuable help.

From the detailed information now available concerning the genetics, behavior, ecology and other aspects of various groups of Hawaiian drosophilids it is clear that the secondary sexual characters which have resulted from selection pressures brought on by changes in mating behavior are often completely unreliable in determining relationships and certainly are not of generic or in most cases even of subgeneric importance. As demonstrated by Kaneshiro (in press) these characters found only in the males are probably of not more than species group importance. These conclusions are supported by chromosome analysis as well as by the courtship behavior studies.

Spieth (1968) pointed out that the pattern of courtship behavior displayed by the *Antopocerus* species clearly indicates close relationship to other Hawaiian *Drosophila*; these share in common a number of distinctive behavioral elements. Also Yoon, *et al.* (1972) and Yoon and Richardson (in press) have shown a high degree of cyto-

[1] Published with the approval of the Director of the Hawaii Agricultural Experiment Station as Journal Series No. 2035. The financial support for this work was from National Science Foundation Grant GB29288.

genetic convergence between *Antopocerus* and *Drosophila* and the two must be considered congeneric. Since there are distinctive morphological features which will clearly differentiate these and no known intermediates or direct intergrades with other *Drosophila* it is best, for convenience sake, to treat *Antopocerus* as a subgenus.

From the evidence obtained by comparisons of the male genitalia, the internal anatomy (Throckmorton, 1966), the leaf breeding habits (Heed, 1971) and the courtship and mating behavior (Spieth, in conversation) this group is phylogenetically close to, and probably derived from, one of the modified tarsi groups. The *Antopocerus* evolved on Maui Nui (Maui-Molokai-Lanai group of Islands), and radiated out to Hawaii and Oahu. Fifteen species are now known; ten from Maui Nui, four from Hawaii, and one from Oahu. The group is not represented on the island of Kauai.

Spieth (1966) found the species which he studied fit into three distinct groups, based upon male courtship patterns. These correspond to the species groups which we have set up and also, for the most part, to the groupings of Yoon and Richardson (1976) based upon choromsome analysis.

The species are arranged in the following groups: Adunca, diamphidiopoda and villosa.

Key to Species of *Drosophila* (*Antopocerus*), Based Upon Males

1 Front basitarsus with very long, posterior, preapical bristle, which extends beyond apex of tarsus; also with clump of erect, moderately long, dorsal hairs occupying 2nd tarsomere and apex of basitarsus (fig. 7). 2

— Basitarsus lacking such a bristle or as above. 5

2(1) Front tibia with long, curled, conspicuous hairs (fig. 6–8). 3

— Front tibia lacking long hairs (fig. 9). Hawaii ..... *tanythrix* (Hardy)

3(2) Front tibia with 6–7 long, ventral hairs and at least 3 dorsals (fig. 7–8). 4

— Front tibia with only 3 ventral and no long dorsal hairs (fig. 6). Hawaii ..... *yooni* new species

4(3) Front tibia with 8–10 long hairs extending along entire dorsal margin (fig. 7). Hawaii ..... *cognata* Grimshaw

— Front tibia with only 3, or sometimes 4, dorsal hairs arranged near middle of segment (fig. 8). Molokai, Maui, Lanai ..... *diamphidopoda* (Hardy)

5(1) Front tibia lacking long hairs, except for 1 anterior at apex in *longiseta* (fig. 19). Basitarsus subequal in length to tibia; 2nd tarsomere longer than 3rd (fig. 18–19). 6

— Tibia with long, conspicuous hairs, usually as long as basitarsus. Basitarsus usually about ½ as long as tibia. Second tarsomere rudimentary, shorter than 3rd (fig. 17). 7

6(5) Wing expanded on apical ½, costa arcuate beyond middle so wing is broadest beyond m crossvein. Front tibia with an apical, anterior

hair (fig. 19). Second tarsomere 2 times 3rd and ⅓ as long as basitarsus. Molokai ..... *longiseta* Grimshaw

— Wing normal in shape. Tibia lacking apical hair. Second tarsomere just slightly longer than 3rd (fig. 18). Maui ..... *aduncа* (Hardy)

7(5) Wings hyaline, with brown spot at apex (fig. 24). 8

— Wings subhyaline to uniformly faintly brownish fumose; no brown markings. 9

8(7) Thorax all brown, tinged with red in ground color. Wing spot filling apices of cells R_1, R_3 and R_5 and sometimes extending into upper apex of cell 2nd M_2 (fig. 24). Molokai ..... *stigma* new species

— Thorax yellow, with broad, brown, median vitta the full length of mesonotum and over disc of scutellum; plus narrower brown vitta on each side behind humerus, extending almost to postalar bristles, interrupted at suture. Apical brown mark smaller, confined to apex of R_3 and upper ½ of R_5 (fig. 23). Maui ..... *apicalis* new species

9(7) Basitarsus not with dense clump of black hairs near base. Hairs of dorsal portion of tibia much shorter than those on venter. 10

— Basitarsus with fascicula of long, anterodorsal hairs near base. Tibia with long, black villose hairs on both ventral and dorsal surfaces (fig. 12–13). 13

10(9) Costa gently convex, arched beyond middle so wing is broadest beyond m crossvein. Front tibia with numerous long, ventral and posterior hairs extending full length and lacking clump of anterior hairs at apex. No clump of hairs at apex of basitarsus and 2nd tarsomere. Fourth tarsomere not lobate (fig. 14, 15, 17). 11

— Costa straight, anterior and posterior margins of wing almost parallel sided. Tibia not with rows of hairs extending full length of segment. Hair clump present at apex of basitarsus and on 2nd tarsomere; 4th lobate at apex (fig. 10 and 11). 14

11(10) Tarsi with prominent long hairs (fig. 14 and 17). 12

— Tarsi lacking long hairs (fig. 15). Maui ..... *entrichocnema* (Hardy)

12(11) Thorax mostly brown, with rather distinct vittae on mesonotum. Front bastitarsus elongate, subequal in length to tibia. Tibia strongly curved. Ventral hairs of front tibia very long compared to short posterior hairs. Basitarsus with strong posterodorsal hair and with other hairs as in fig. 17. Kipahulu, Maui ..... *curvata* new species

— Mostly yellow species. Basitarsus about ½ as long as tibia. Tibia nearly straight, dorsal row of hairs longer than ventral hairs. Basitarsus with row of moderately long, dorsal cilia from near base to apex and another row of posterodorsals over apical ⅗ (fig. 14). Oahu ..... *arcuata* (Hardy)

13(9) Thorax mostly yellow to rufous, with 3 brown longitudinal vittae on mesonotum. Fascicula on front basitarsus consisting of about 12 closely placed, long, black hairs (fig. 12). Maui ..... *villosa* (Hardy)

— Thorax nearly all subshining black, mesonotum not distinctly vittate. Fascicula on front basitarsus consists of 5 hairs (fig. 13). Molokai .... *nigricolor* new species

14(10) Mesonotum with pair of brown longitudinal vittae. Mesopleuron and upper pteropleuron brown. Only 2 ventral hairs on front tibia,

these much shorter than dorsal hairs; latter are arranged from basal ¼–⅓ to about apical ⅔ of tibia (fig. 10). Maui ..... *orthoptera* (Hardy)

— Mesonotum and pleura all yellow. Tibia with 5 ventral hairs, these equal in length to dorsal hairs; latter are arranged from basal ⅔ to apical ⅓ of segment (fig. 11). Hawaii ..... *kaneshiroi* Hardy

The Adunca Group of Species

Containing the species *adunca* (Hardy), from Maui, and *longiseta* Grimshaw, from Molokai.

Differentiated by having front tibia of male devoid of long curled hairs, except for one anterior hair at apex in *longiseta* (fig. 19). Basitarsus elongate, subequal in length to tibia. Second tarsomere longer than third, remainder of tarsi normal. Wing with fuscous markings anteroapically, costal margin convex, wing widest beyond m crossvein.

As discussed by Spieth (1968), it is logical to conclude that the ancestral stock of *Antopocerus* arose in the Maui Nui complex of islands (Maui-Molokai-Lanai) less than 1.8 million years ago, and the most primitive decendents are now represented by *adunca*, from Maui, and *longiseta*, from Molokai. The courtship behavior is similar in these two and represents the most primitive pattern in the subgenus *Antopocerus*. On the basis of morphological characteristics one would have to conclude that *adunca* is the more primitive and that *longiseta* is the derived species. The *Antopocerus* characteristics of the scape of the male antenna and the modification of the front legs are fully developed in *adunca* but the arista of the antenna has short, distinctly spaced hairs along the dorsal surface (fig. 2) rather than the dense, long pilosity (fig. 3) or villosity (fig. 5) characteristic of the derived species. Also the wing is like typical *Drosophila* in shape, rather than with the costal margin arcuate beyond middle as in *longiseta*, or completely straight, as in the diamphidiopoda group of species (fig. 21). If *adunca* is considered the probable ancestral type, this would indicate that the subgenus could have evolved after West Maui was formed, 1.15–1.3 million years ago (Spieth, 1968) rather than 1.8 million years ago when West Molokai appeared.

Yoon and Richardson (1976) state that "based upon biogeographical, behavioral and cytogenetic information *A. longiseta* from Molokai is tentatively identified as the primitive species of the subgenus." However, on the basis of chromosome analysis they state that *adunca* could have been derived from or given rise to either *longiseta* or *arcuata*. The former is distinctive from both of these by having six pairs of rods in the metaphase configuration. On morphological characteristics *arcuata* would not appear to fit in the same group with *longiseta*. The courtship behavior has not been studied for this species so there is still a question as to where it correctly fits.

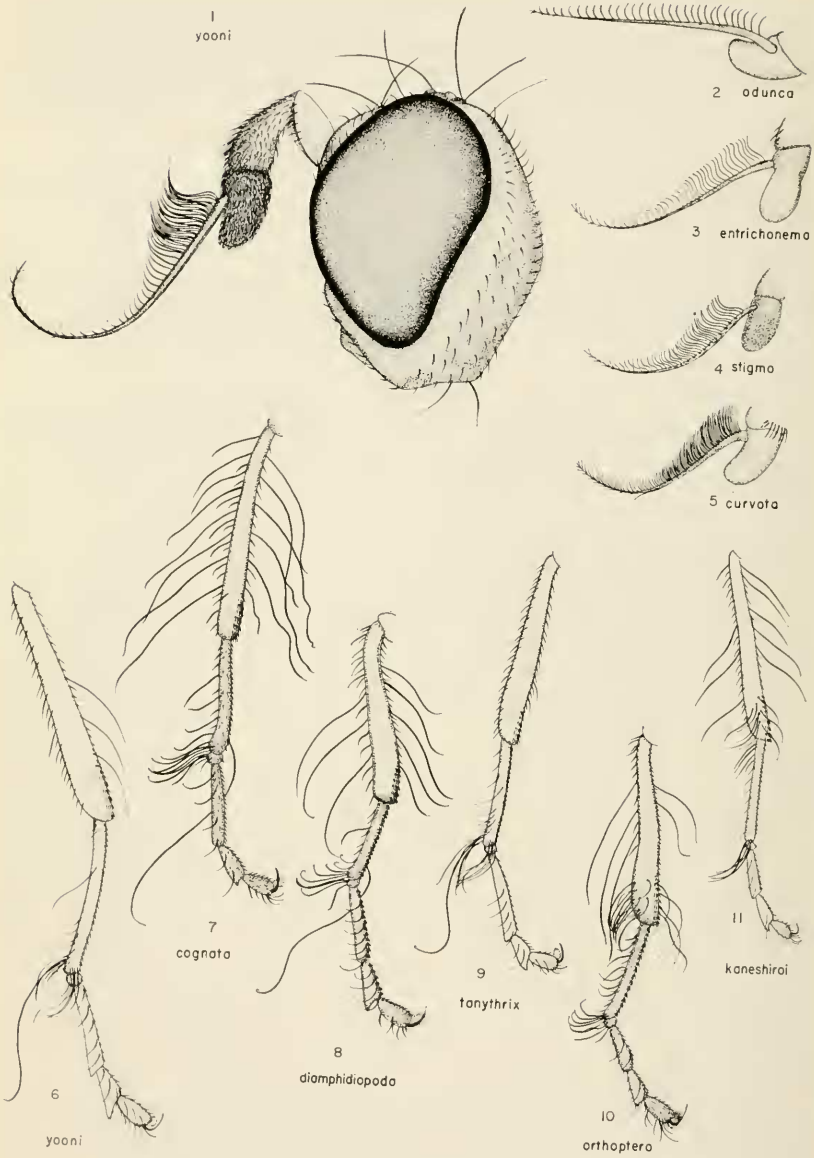

Plate 1.

Fig. 1, head of *Drosophila* (*Antopocerus*) *yooni*, lateral view. Fig. 2–5, third antennal segment and arista. 2, *adunca*. 3, *entrichocnema*. 4, *stigma*. 5, *curvata*. Fig. 6–10, front legs of males, anterior view. 6, *yooni*. 7, *cognata*. 8, *diamphidiopoda*. 9, *tanythrix*. 10, *orthoptera*. 11, *kaneshiroi*. (Please note that the correct spelling for fig. 3 is *entrichocnema*.)

The Diamphidiopoda Group of Species

Containing the following species: *Cognata*, from Hawaii; *diamphidiopoda*, from Maui, Molokai and Lanai; *kaneshiroi*, from Hawaii; *orthoptera*, from Maui; *tanythrix*, from Hawaii; and *yooni*, from Hawaii.

Characterized by males having the costal margin straight, with wing comparatively narrow, the front and hind margins nearly parallel and wing broadest in median portion (fig. 21). Also the wing is evenly infuscated, faintly brownish, lacking distinct brown markings. The front basitarsus is about half to two-thirds as long as the tibia, with a very long, pre-apical, posterior bristle, except in *orthoptera* and *kaneshiroi*, extending beyond apex of tarsus (fig. 6); also with a clump of erect anterior, bristlelike hairs at end of basitarsus and on second tarsomere. Second tarsomere is rudimentary, wider than long. Third tarsomere flattened dorsally, rather elongate, subequal to length of basitarsus. Fourth tarsomere has a characteristic dorso-apical, pointed lobe (fig. 6–11). The front tibia is slightly curved on the anterior surface and usually with long curved hairs on ventral and, or, dorsal margins (fig. 6–8, 10–11).

In one of the species, *cognata*, the long dorsal hairs of the arista extend in a close set, single row to the base (as in fig. 3) while in *diamphidiopoda*, *orthoptera*, *kaneshiroi*, *tanythrix* and *yooni* the dorsal vestiture on basal portion of arista is much denser and the hairs are arranged in two or more rows (as in fig. 4–5).

It is probable that *diamphidiopoda*, from Molokai, Maui, and Lanai, is representative of the ancestral type of this group. *Drosophila orthoptera*, from Maui, was probably derived from a *diamphidiopoda*-like ancestor and differs by a reduction in the number of long hairs on the front tibia and by lacking the long apical posterior bristle on the front basitarsus (fig. 10); it then gave rise to *kaneshiroi*, from Hawaii. As pointed out by Spieth (1968) *orthoptera* and *diamphidiopoda* fit in the same group according to courtship behavior but *orthoptera* is more specialized (the behavior of *kaneshiroi* has not been studied).

It would then seem likely that *diamphidiopoda*, or a like ancestor, invaded Hawaii and evolved into *cognata*, then *yooni* and *tanythrix*; the evolutionary pattern has involved the reduction of long hairs on the front tibia (fig. 6–10). The aristae of these, except for *cognata*, are of the *longiseta* type, with two or more rows of villose hairs on basal third. Yoon and Richardson (1976) also concluded that *yooni* fits phylogenetically between *cognata* and *tanythrix*.

The diamphidiopoda group of species fits Spieth's courtship behavior pattern type II (1968). Yoon and Richardson (1976) in their studies of patterns and rates of chromosome evolution in the *Antopocerus* studied all of the species of the group except *orthoptera* and *kaneshiroi*. Based upon the chromosome analysis they placed these in two groups: *diamphidiopoda* and *cognata* fitting together by having homosequential polytene chromosomes but with differences in the metaphase configuration and *tanythrix* and *yooni* fitting to-

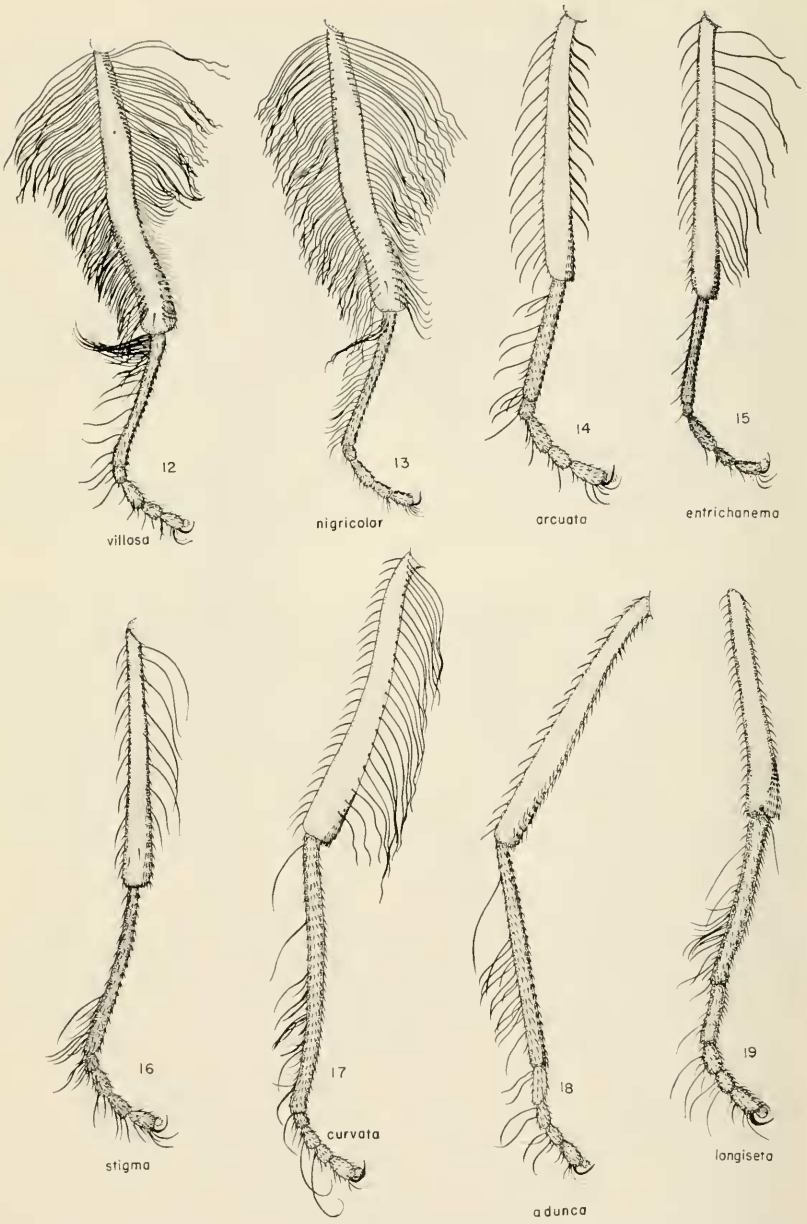

Plate 2.

Fig. 12–19, front legs of males, anterior view. 12, *villosa*. 13, *nigricolor*. 14, *arcuata*. 15, *entrichocnema*. 16, *stigma*. 17, *curvata*. 18, *adunca*. 19, *longiseta*. (Please note that the correct spelling for fig. 15 is *entrichocnema*.)

gether by sharing three unique inversions. They conclude that *tanythrix* and *yooni* were probably derived from *diamphidiopoda* although at present "it is not clear if these species evolved linearly, or divergently from a common ancestor."

Drosophila (*Autopocerus*) *kaneshiroi* Hardy, new species
fig. 11

Very close to *orthoptera*, from Maui, and the two form a complex of the diamphidiopoda group of species characterized by lacking the long, posterior, preapical bristle on front basitarsus. The only character I find for differentiating these is in the ornamentation of the front legs of the males and in the coloration of the thorax.

Drosophila kaneshiroi has the thorax all yellow, lacking brown markings. The front tibia has 5 long ventral bristles arranged from near base to apical ⅗ of segment, these are equal in size to the dorsal hairs. Three dorsal hairs are arranged from just below middle to apical ⅕ of segment. Front basitarsus with 3 prominent anterodorsal hairs in a row at base. Other details of the front legs as in fig. 11. *Drosophila orthoptera* is characterized by having a pair of longitudinal, submedian, brown vittae down the mesonotum and the mesopleura and upper sternopleura brown. Only 2 ventral hairs are present, situated at about basal ⅓ of tiba, these are short compared to the dorsal hairs. The 3 dorsal hairs are subequal in length to the tibia and are arranged from basal ¼–⅕ to apical ⅔ of segment (fig. 10). The front basitarsus lacks the 3 basal, anterodorsal hairs present in *kaneshiroi*. *Drosophila kaneshiroi* otherwise fits the description of *orthoptera* and obviously was derived from that species.

Length of male: Body, 4.8 mm; wing, 4.55 mm by 1.35 mm width.

Female. Fitting the description of the male except for secondary sexual characters and except for a tinge of brown in the ground color of the mesonotum. The first tergum is entirely yellow and the sides and anterolateral portions of terga 2 to 4 are conspicuously pale yellow. The female wing is like typical *Drosophila* in shape.

Length: Body, 4.5 mm; wing, 5.25 mm.

This species is named after Dr. K. Y. Kaneshiro, University of Hawaii, the project coordinator for the Evolution of the Hawaiian Drosophilidae studies. He has worked with this project since its onset in 1963 and much of the research accomplishments have been due to his efforts and talents.

Holotype male, Manuka Forest Reserve, South Kona, Hawaii, June 26, 1976 (S. L. Montgomery). One female, same data as type, it is not being designated as a paratype because of the lack of differentiating characters in females of *Antopocerus*. Type in B. P. Bishop Museum. Female specimen in University of Hawaii collection.

Drosophila yooni Hardy, new species
fig. 1, 6, 21

This species fits in the diamphidiopoda group by having the costal margin straight, the front basitarsus with a very long, pre-apical, posterior bristle and fitting the other characters of this group. This species appears to fit intermediate

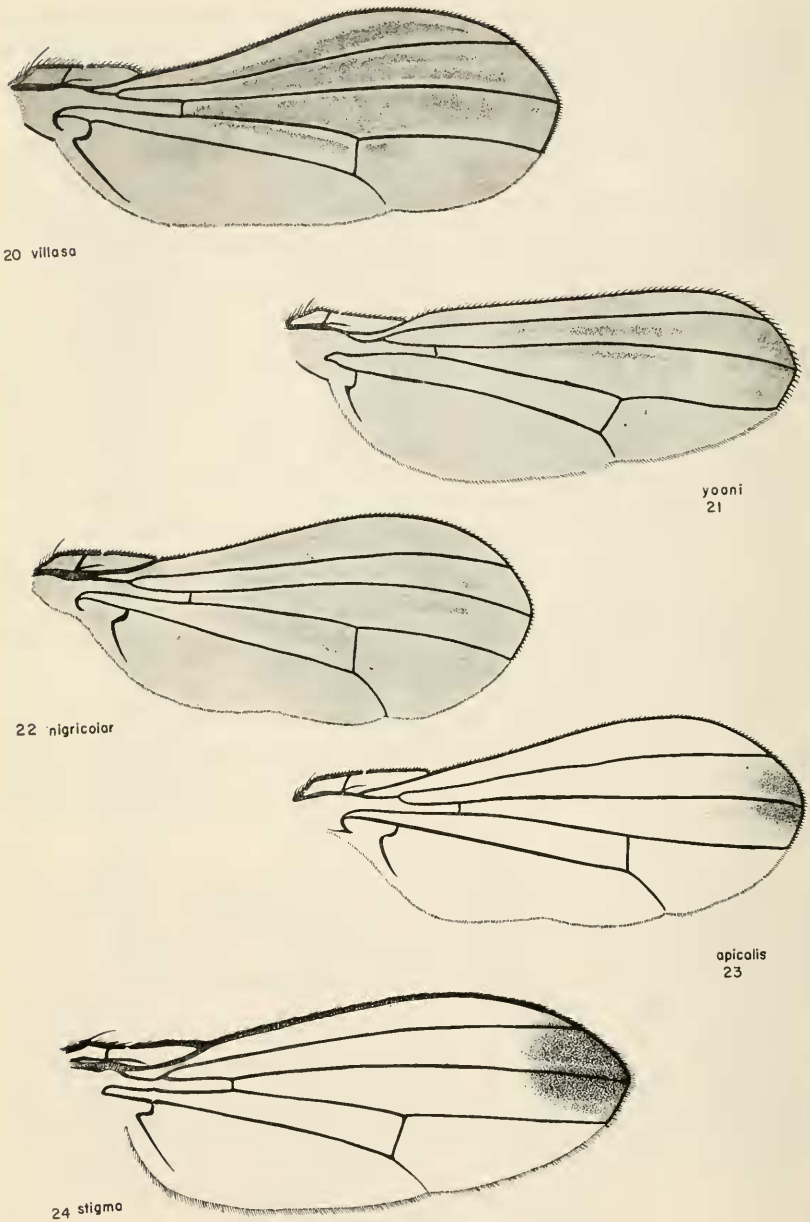

Plate 3.

Fig. 20–24, wings. 20, *villosa*. 21, *yooni*. 22, *nigricolor*. 23, *apicalis*. 24, *stigma*.

between *cognata* and *tanythrix* differing from the 1st by the reduction in number of long cilia on the tibia; having only 3 ventral and no long dorsals (fig. 6), rather than with 6 ventrals and 8–10 dorsals (fig. 7), and from *tanythrix* by having 3 long ventral hairs. It is obviously closely related to the latter and the 2 occur sympatrically on the island of Hawaii. The courtship behavior of *yooni* fits it in the diamphidiopoda group (Spieth, in conversation).

Morphologically *yooni* and *tanythrix* are very similar. The only character we find for differentiating these is in the development of the long ventral hairs of the front tibia of the male, the 3 hairs are evenly spaced from about middle to apical ¼ of segment and all extend to or beyond the apex of the tibia (fig. 6). In *tanythrix* the ventral hairs are poorly developed, 2 slightly curved hairs, scarcely larger than the other leg setae, are situated near the apical ⅓ of segment (fig. 9).

Drosophila yooni would otherwise fit the characteristics of other species of the diamphidiopoda group of species: i.e. Head of male as in fig. 1. First antennal segment yellow, remainder dark brown, tinged with red. Thorax yellow, tinged with brown on dorsum. Wings evenly fumose shaped as in fig. 21. Front tibia and tarsus of male as in fig. 6. Abdomen mostly brown, yellow on venter and on sides and anterolateral margins of terga.

Length: Body, 4.0 mm; wing, 4.6 mm.

Female unknown.

Holotype male, upper Olaa Forest Reserve, Wright Road, Hawaii, 3,800 ft., July 25, 1975 (H. T. Spieth). Thirty-one paratypes, all males; some same data as type, and some same locality as type, June 1968 (H. L. Carson and M. P. Kambysellis); Rangers Cabin, Kilauea, Hawaii, March 1966 (W. B. Heed); Keanakolu, Hawaii, 4,000 ft., June 1966 (W. B. Heed); and Kahuku Ranch Road, S. Kona, Hawaii, 3,800 ft., May 1976 (K. Y. Kaneshiro).

Type and series of paratypes in the B. P. Bishop Museum. Paratypes deposited in the collections of the U. S. National Museum, British Museum (Natural History), University of Texas and University of Hawaii.

It is a pleasure to name this species after Dr. Jong Sik Yoon, University of Texas, whose studies of the cytogenetics of *Antopocerus* and other Hawaiian *Drosophila* have been most important contributions to our understanding of this fauna.

The Villosa Group of Species

Consisting of *villosa,* from Maui; *entrichocnema,* from Maui; *curvata,* from Maui, *nigricolor,* from Molokai and *arcuata,* from Oahu; also *apicalis,* from Maui and *stigma,* from Molokai, which belong in the apicalis complex of species.

Characterized by having long, curled, densely placed, ventral and short to long dorsal hairs extending over most of the front tibia of the male (fig. 12–17). Second tarsomere slightly longer than wide; third not modified, about two times longer than second; fourth tarsomere not lobate. Wings infuscated, faintly brownish with no distinct dark markings except in the apicalis complex; costal

margin convex beyond middle of wing. Mesonotum with a rather prominent broad, dark brown median vitta, except in *nigricolor* and *arcuata*. The basal portion of the arista has two or more rows of densely placed, villose hairs along the dorsum in six of the species (fig. 4–5) and a single row of closely placed hairs in *entrichocnema* (as in fig. 3). The latter may be the most primitive of this group.

The position of *arcuata* is not clear. The chromosome analysis (Yoon and Richardson, 1976) would seem to place it near *longiseta*. We cannot confirm this on the basis of morphological characters. The courtship behavior of *arcuata* has not yet been studied. The latter species is the only one of this group for which chromosome analysis has been made (Yoon and Richardson, 1976).

Drosophila curvata Hardy, new species
fig. 5, 17

Fitting the villosa group of species but readily differentiated by the ornamentation of the front legs of the male (fig. 17). It fits nearest to *arcuata*, from Oahu, based upon morphological characters but these do not appear to be related. The courtship behavior or chromosomes of *curvata* have not been studied.

Drosophila curvata differs from *arcuata* by having the thorax mostly brown with 3 dark brown vittae down mesonotum. By having front tibia of male strongly curved on anterior surface with very long hairs along ventral surface and rather short, suberect hairs along dorsal surface (fig. 17). Front basitarsus elongate, subequal in length to tibia and with prominent dorsal hair at base and with about 12 dorsal and posterior hairs on apical ½ of segment. Second tarsomere about 2 times longer than wide and subequal to 3rd. Tarsomeres 2 to 4 each with a strong dorsal hair.

Drosophila arcuata is a mostly yellow species, lacking vittae on the mesonotum. The front basitarsus is comparatively short, about ½ as long as tibia. The tibia is nearly straight and the hairs on dorsal surface are longer than those on ventral (fig. 14). The basitarsus has a row of moderately long dorsal hairs from near base to apex and the 2nd tarsomere is about as wide as long and scarcely ½ as long as 3rd.

Otherwise *curvata* fits the characteristics of *villosa*, having 2 or more rows of densely placed dorsal hairs on basal ⅓ of arista (fig. 5); wings evenly brownish fumose and costal margin distinctly arcuate as in fig. 20.

Length: Body 5.8 mm; wings, 6.3 mm.

Female unknown.

Holotype male and one male paratype, Kipahulu Valley, Maui, 3,100 ft., August 5–10, 1961 (K. Y. Kaneshiro). Type in B. P. Bishop Museum, paratype in University of Hawaii collection.

Drosophila nigricolor Hardy, new species
fig. 13, 22

Fitting close to *villosa*, from Maui, and the only characters we find for separating these is the body coloration and the ornamentation of the front legs. In *villosa* the thorax is typically yellow to rufous with 3 brown, longitudinal vittae on mesonotum and with a tinge of brown over the disc of the scutellum; also

a faint tinge of brown often present over median portion of mesopleuron and upper pteropleuron. The thorax of *nigricolor* is mostly shining black, lightly brownish pollinose over the dorsum, gray on sides. In the type the mesonotum is entirely black, except for a faint tinge of red in the ground color on the anterior portion above each humerus. The scutellum is entirely black and most of the mesopleuron and upper pteropleuron are black. The sternopleuron, metapleuron and metanotum are reddish brown, tinged with black. The propleuron, lower ⅔ of pteropleuron, portion of mesopleuron surrounding spiracle and the hypopleuron are yellow. In some of the paratypes the area on each of mesonotum anterior to and in line with the dorsocentral bristles is brownish red giving the appearance, in strong direct light, of 2 vittae extending from anterior margin as far as anterior dorsocentral bristles. The front legs are very similar in the 2, the most striking difference is the comparatively sparse fascicula of the front basitarsus of *nigricolor*; consisting of only 5 long black hairs (fig. 13) rather than about 12 hairs (fig. 12). Also in *nigricolor* the hairs of the anteroventral row on front tibia are consistently longer toward the apical portion of the segment than in *villosa*. Otherwise fitting description of *villosa*. The wing is as in fig. 22.

Length: Body and wings 5.8–6.0 mm.

Female unknown.

Holotype male from Waikolu Stream, Hanalilolilo, Molokai, 3,800 ft., May 7, 1976 (K. Y. Kaneshiro). Three male paratypes same data (K. Y. Kaneshiro and H. T. Spieth). Type and one paratype in B. P. Bishop Museum, other paratypes in collection of the University of Hawaii.

The Apicalis Complex of Species

Comprised of *apicalis*, from Maui, and *stigma*, from Molokai.

Fits the villosa group of species and characterized by having the costal margin only slightly convex beyond middle; wing hyaline with a prominent apical brown spot (fig. 23–24); also the second tarsomere is slightly longer than wide (fig. 16). The characteristics of the male legs seem to be the same in the two species. The chromosomes have not yet been studied and the mating behavior has not been completely worked out.

The dorsal vestiture of the arista is very dense in *apicalis* with the hairs arranged in two or more rows at base. While in *stigma* the dorsal hairs are slightly spaced, arranged in two irregular or partial rows at base (fig. 4). This may be an indication that the latter is the more primitive of the two.

Drosophila apicalis Hardy, new species
fig. 23

Near *stigma*, from Molokai, and differentiated by having the thorax yellow with a broad, brown, median vitta extending the full length of the mesonotum and over disc of scutellum, also with a narrower brown vitta on each side behind humerus, extending nearly to postalar bristles, interrupted at suture. The apical brown mark of the wing is smaller than in *stigma*, confined to apex of cell R_1 and upper ½ of R_5 (fig. 23). The dorsal hairs on the arista are in pairs (2 rows) on the basal portion.

Male. Head: Shape and chaetotaxy as in other *Antopocerus*. Front and upper occiput brown pollinose, otherwise yellow. Antennae mostly dark brown, yellow on undersides of 1st 2 segments. Arista more nearly like fig. 5, with dorsal hairs densely placed on basal portion. *Thorax*: Yellow except for 3 brown vittae down mesonotum. *Wings*: Hyaline with brown spot in apex as in fig. 23; costal margin slightly convex beyond middle. *Legs*: Yellow. Front tibia slightly curved on anterior surface, with 8 to 9 long, curved, black ventral hairs on basal ½ and row of short, nearly straight, recumbent dorsal hairs extending full length of segment; a few small setae are present on anterior surface just before apex. Basitarsus slender, slightly curved on anterodorsal surface and about ⅔ as long as tibia. The basal ⅔ of basitarsus devoid of long hairs; a strong anterior hair present on apical ⅔ to ¾, this extends as far as apex of 2nd tarsomere. Also numerous erect, slightly curled, anterior and dorsal hairs present before apex of basitarsus and 2nd tarsomere. Second tarsomere slightly longer than wide, 3rd and 4th normal and other details of front legs as in fig. 16. *Abdomen*: Mostly dark brown, yellow over 1st tergum and posterolateral portions of terga 2 to 5. Genitalia yellow.

Length: Body and wings, 5.0–5.25 mm.

Female similar to male except for secondary sexual characters, also the apical wing spot is faint, not clearly developed.

Holotype male and allotype female, Auwahi, Maui, 3,400 ft., July 11, 1974 (K. Y. Kaneshiro). Sixteen male paratypes, all from same locality as type, collected from November to August 1965, 1969 and 1974 (K. Y. Kaneshiro, J. K. Fujii, J. P. Murphy and H. L. Carson). Type, allotype and some paratypes in B. P. Bishop Museum. Other paratypes in collections of the U. S. National Museum, British Museum (Natural History) and the University of Hawaii.

Drosophila (*Antopocerus*) *stigma* Hardy, new species
fig. 4, 16, 24

This is closely related to *apicalis*, from Maui, and the 2 are readily separated from other *Antopocerus* by having the wings hyaline with a conspicuous brown spot at apex (fig. 24). It is differentiated from *apicalis* by having the thorax dark brown, tinged with rufous in ground color, lacking vittae on mesonotum. The apical wing spot comparatively large, filling apices of cells R_1, R_2, and R_5 (fig. 24) and sometimes extending into upper apex of cell 2nd M_2. Also the dorsal vestiture of the arista is arranged in 2 irregular rows of long curved hairs (fig. 4); in some specimens only a single row is apparent, 1 or 2 of the basal hairs may be paired and the validity of this character is not understood.

Otherwise fitting description of *apicalis*, the front legs of the male are as in fig. 16.

Length: Body and wings 5.0–5.25 mm.

Female. Fitting description of male except for secondary sexual characters.

Holotype male, Hanalilolilo, Molokai, 3,500 ft., Jan. 9–11, 1975 (A. Ohta). Allotype female, Puu Kolekole, Molokai, 3,600 ft., July 20, 1964 (H. L. Carson). 19 male paratypes from the following

localities on Molokai: Same as type (some collected by W. Ibara); same as allotype, June 1964–July 1965 (D. E. Hardy and H. L. Throckmorton); Hanalilolilo Trail, 3,500 ft., November 12, 1967 (H. L. Carson); S. of Hanalilolilo, July 1964 and 1975—March 1966 (W. B. Heed, H. T. Spieth and H. L. Carson); and Kaunuohua, July, 1969 (H. L. Carson). Type and some paratypes in the B. P. Bishop Museum. Remainder of paratypes in the collections of the U. S. National Museum, British Museum (Natural History) and the University of Hawaii.

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